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MINERAL RESOURCES AND MINERAL INDUSTRIES OF THE EXTREME SOUTHERN ILLINOIS REGION

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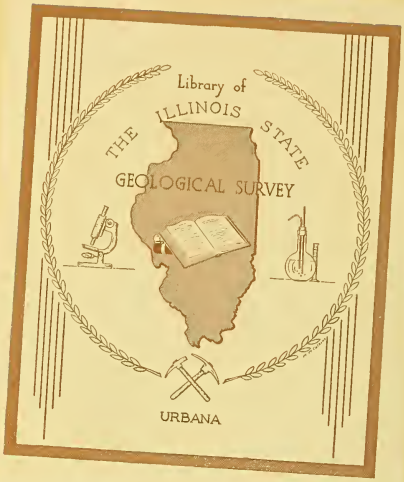

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MINERAL RESOURCES AND MINERAL INDUSTRIES OF THE EXTREME SOUTHERN ILLINOIS REGION

Robert L. Major

A B S T R A C T

The mineral resources and the mineral extraction and processing facilities of the Extreme Southern Illinois Region are described and discussed in this report. The Extreme Southern Illinois Region includes Alexander, Hardin, Johnson, Massac, Pope, Pulaski, and Union Counties. Although the region's mineral industries produced only $21 million worth of goods, or 3.4 percent of the state total, their contribution to the economy of the region is significant.

The area is the leading producer of fluorspar in the United States. Lead and zinc concentrates are produced as co-products with fluorspar, but their final processing is carried out elsewhere. Other mineral materials produced in this region include crushed and broken limestone, cement, sand and gravel, silica (tripoli), ganister, processed clay, and dimension stone. Mineral processing facilities include fluorspar mills, silica grinding plants, and a clay processing plant. No petroleum has ever been discovered in this region, and coal production has been sporadic, the last production having been reported in 1956.

INTRODUCTION

This is the second in a series of eight projected reports on the mineral resources of the state of Illinois prepared by the Mineral Economics Group of the Illinois State Geological Survey with the assistance of other Survey personnel. Each report considers a particular region of the state, this one dealing with the Extreme Southern Illinois Region, which comprises the seven southernmost counties of Illinois—Alexander, Hardin, Johnson, Massac, Pope, Pulaski, and Union. The region is bounded by the Mississippi River on the west and by the Ohio River on the east and south (fig. 1).

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Figure 1 - Index map of the Extreme Southern Illinois Region.
(Shaded area indicates previously completed report.)

TABLE 1—EMPLOYMENT IN AND PAYROLL OF THE MINERAL INDUSTRIES IN FOUR COUNTIES IN EXTREME SOUTHERN ILLINOIS*

County	Employees	Payroll ($1000)
Alexander	50	176
Hardin	837	3,668
Pope	17	56
Union	80	285
Total	984	4,185
State total	27,482	144,359

* Data are not available for Johnson, Massac, and Pulaski Counties. Massac County has one cement plant, three sand and gravel operations, and one stone quarry; Johnson County has three stone quarries; and Pulaski County has one clay processing plant and two sand and gravel operations. Therefore, the total employment and payroll of the mineral industries in southern Illinois is considerably larger than is shown above.

Although the Extreme Southern Illinois Region contributes only about three percent of the value of the state's total mineral production, it is the leading producer of several commodities. Hardin and Pope Counties produce all of the state's fluorspar and about half of its lead and zinc. Alexander County produces all of the state's silica (tripoli) and ganister. In addition, the area produces crushed stone, sand and gravel, and cement. No oil production has ever been reported and the small coal mines located here have been inactive for some years.

The size of the payroll and the number of employees engaged in the mineral industries in selected counties in extreme southern Illinois are given in table 1. Table 2 gives mineral production and value for 1963 and 1964. The total value of regional mineral production in 1964 amounted to $21 million,or about 3.4 percent of the state total. It contributed significantly to the economy of the area, which has practically no manufacturing and relatively little agriculture as sources of income. The main mineral commodities produced in 1964 were, in order of their dollar value, cement, fluorspar, stone, zinc, tripoli, lead, clay products, sand, and gravel.

FLUORSPAR, LEAD, AND ZINC

About half of the famous Illinois-Kentucky fluorspar district lies within the Extreme Southern Illinois Region. Traditionally, the district

TABLE 2—MINERAL PRODUCTION IN 1963 and 1964 FOR THE EXIREME SOUTHERN ILLINOIS REGION

Commodity	Quantity (tons)	Value	Operations	Average value ($/ton)
		1963		
Crushed stone	2,727,007	$ 3,334,382	11	$ 1.22
Fluorspar	132,060	6,547,149	13	49.58
Common sand	81,200	72,100	2	.89
Common gravel			2	.88
Lead	---	3,956,512	6	216.00
Zinc			7	230.00
Cement			1	3.01
Tripoli	---	1,119,974	2	26.89
Clay products			1	---
Ganister			1	10.00
Total value		$15,030,117		
		1964		
Crushed stone	2,584,152	$ 3,377,950	12	$ 1.31
Fluorspar	127,454	6,451,755	14	50.62
Common sand	233,000	213,000	4	.92
Common gravel			5	.89
Lead	---	9,853,207	6	262.83
Zinc			6	272.00
Cement			1	3.46
Tripoli	---	1,067,400	2	26.88
Clay products			1	---
Ganister			1	10.00
Total value		$20,963,312		

has been the main domestic source of this mineral, and the Illinois portion presently contributes more than half of the total United States production of fluorspar.

The fluorspar (fluorite) of Illinois occurs in Hardin and Pope Counties, and the headquarters for the mining industry are located in the towns of Rosiclare, Cave in Rock, and Elizabethtown. The mineral occurs in two types of deposits — vein and bedded. The two main areas of production have been the Rosiclare (vein deposits) and Cave in Rock (bedded deposits) Districts (fig. 2). The vein deposits are steeply inclined, sheet-like deposits that occur as fissure fillings along fault zones. The veins usually occur in limestone strata and vary from a few

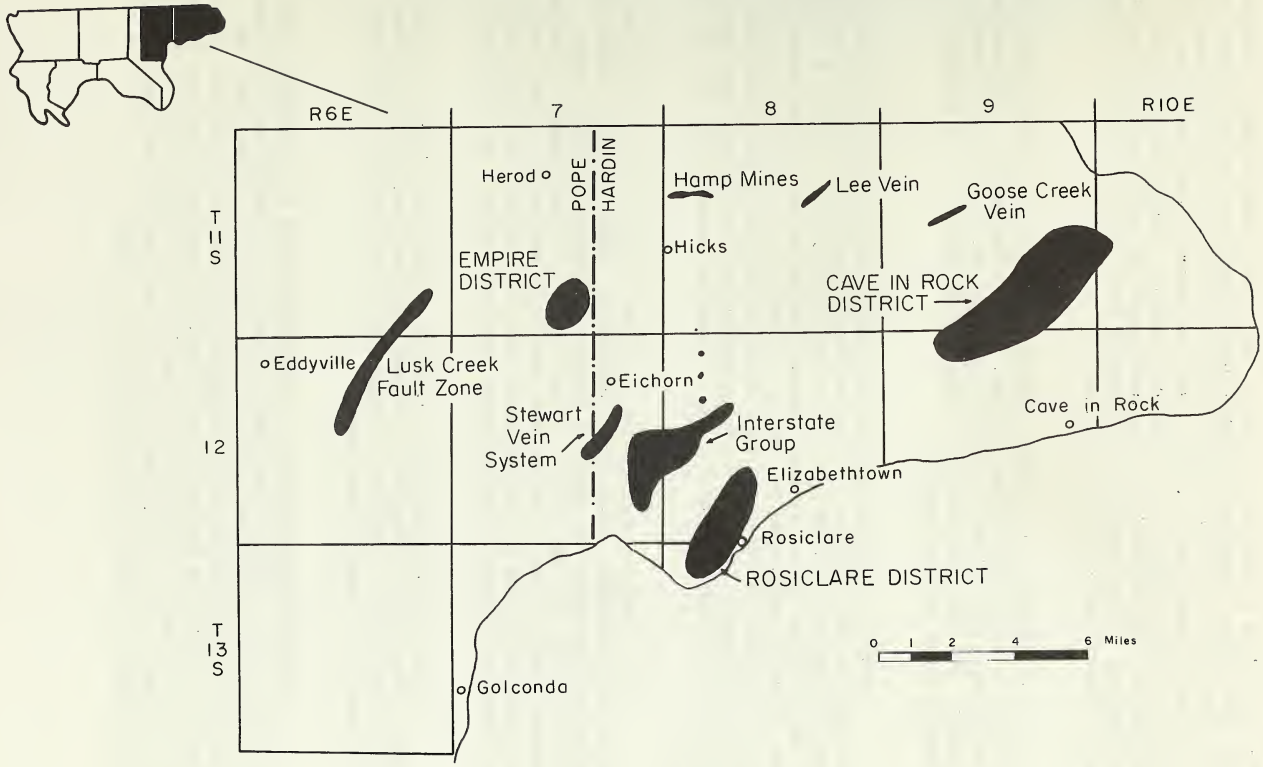

Figure 2 - Principal fluorspar mining districts in the Extreme Southern Illinois Region (from Finger, Risser, and Bradbury, 1960).

inches to 25 feet wide (Lamar, 1965, p. 15). The bedded deposits are generally flat-lying, irregular, elongate bodies that vary in length from 200 to more than 2500 feet, in width from 50 to 300 feet, and in thickness from 4 to 15 feet (Lamar, 1965, p. 17). They are known as replacement deposits because they were formed by the chemical reaction between the fluorine-bearing solutions and the host limestone strata in such a way that the calcium carbonate of the limestone was changed into calcium fluoride or fluorite (Finger, Risser, and Bradbury, 1960, p. 7).

In addition to fluorite, several other minerals are present in the ore deposits, namely sphalerite, galena, barite, and calcite. Sphalerite, an ore of zinc, and galena, an ore of lead, are extracted as co-products. The calcite has little commercial value; barite resources are discussed separately later in this report.

Extreme southern Illinois has always been the most important domestic supplier of fluorspar for the United States market. The historical trends in production and consumption of fluorspar shown in figure 3 indicate that, while United States self-sufficiency has decreased in the face of rising demand, Illinois production has formed an increasing percentage of national output. From 1933 to 1964, Illinois fluorspar shipments increased from 44.0 to 58.7 percent of total domestic shipments. During this same period Illinois' contribution to total U. S. consumption dropped from 30.7 to 14.2 percent.

The fluorspar industry is concentrated mainly in Hardin County, although some fluorspar comes from Pope County. Until recently, there were three major producers—the Aluminum Company of America (ALCOA), Ozark-Mahoning Company, and the Minerva Company—and a varying number of smaller producers. Most of the latter do not have their own mills and must sell their crude ore to one of the companies that do. On July 30, 1965, ALCOA closed down its Illinois fluorspar mine because reserves were depleted.

Generally speaking, the fluorspar industry in Illinois as well as in other states has suffered stiff competition from cheaper foreign ores, Mexican in particular. However, Illinois mines are the most competitive of all domestic fluorspar operations.

Sphalerite and galena are co-products from the fluorspar mines. About eight parts of zinc to one part of lead are recovered with the spar. In the last period for which public data are available (1956-1960), the fluorspar area supplied 40 to 60 percent of the lead production and 25 to 40 percent of the zinc production of Illinois. However, these ratios are increasing because of the shutdown of the Tri-State operation in Jo Daviess County in March, 1963. Eagle-Picher Company was the sole producer left in the northwestern Illinois zinc-lead district in 1966.

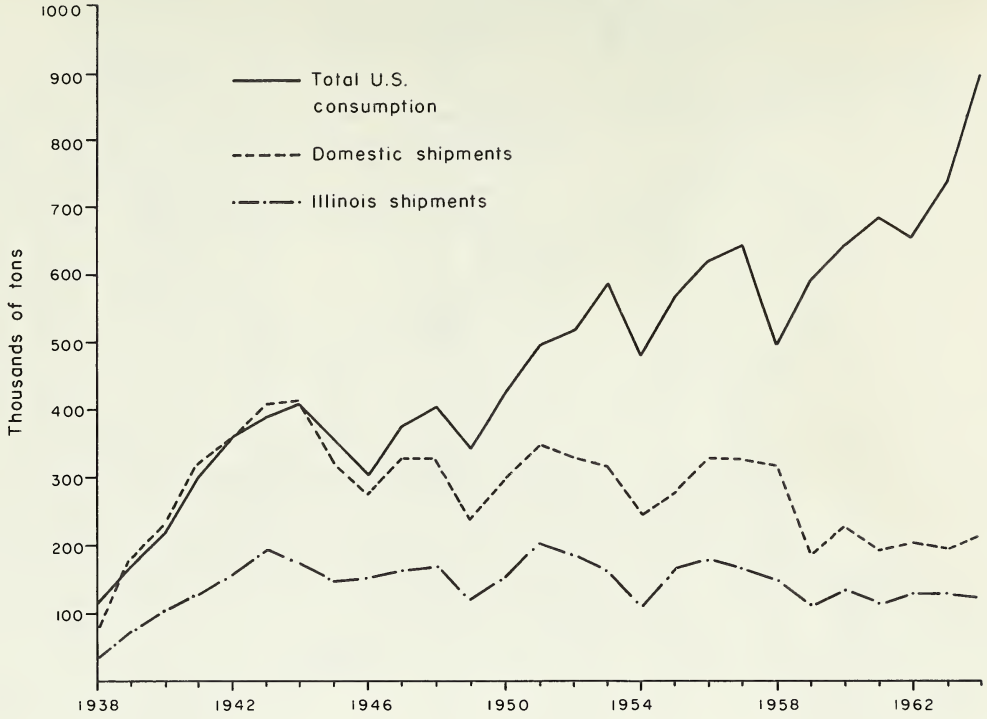

Figure 3 - Fluorspar production and consumption in the United States, 1938 through 1964.

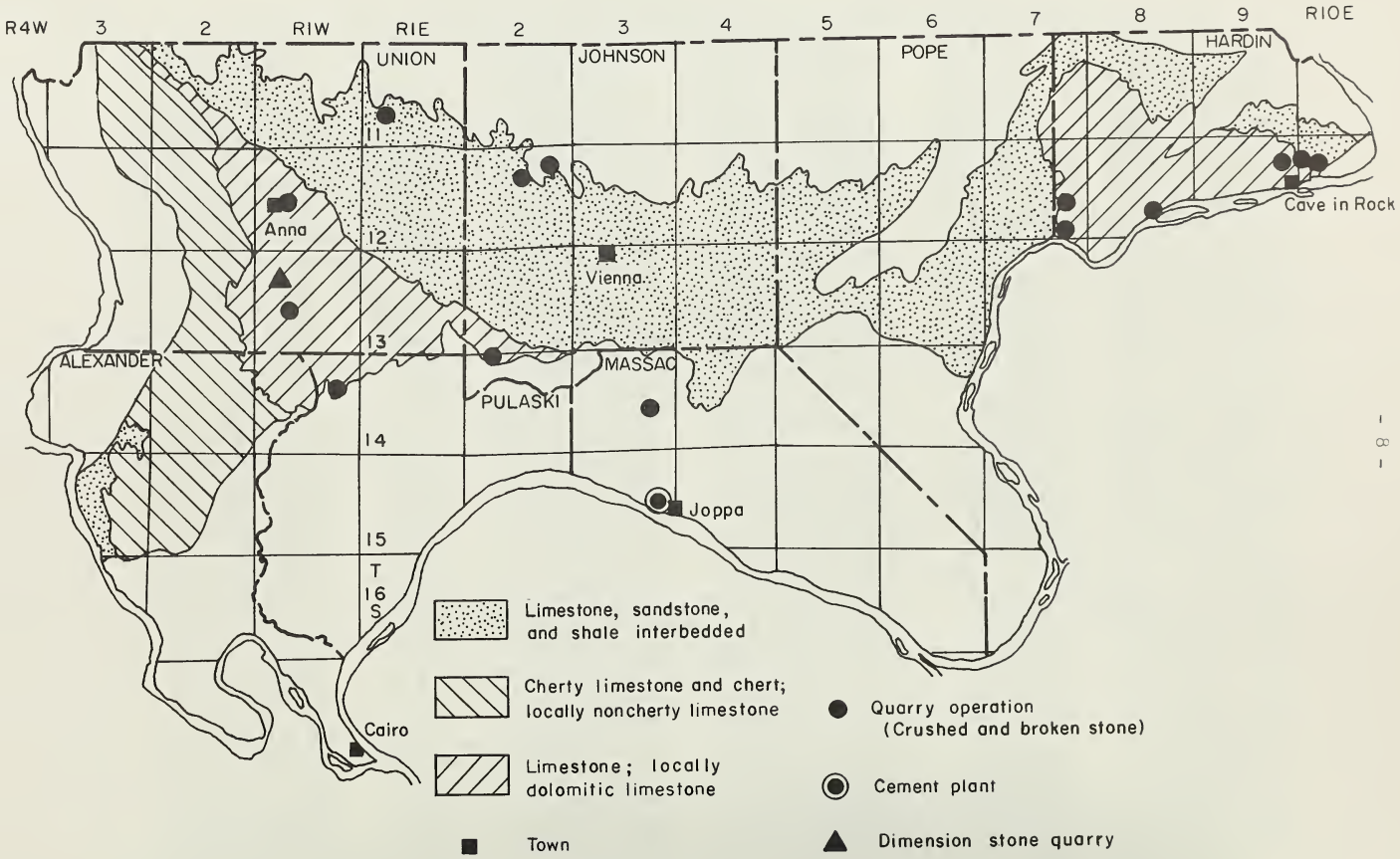

Figure 4 - Limestone and dolomite resources and operations (1964) in the Extreme Southern Illinois Region (geology based on map by Weller, 1939).

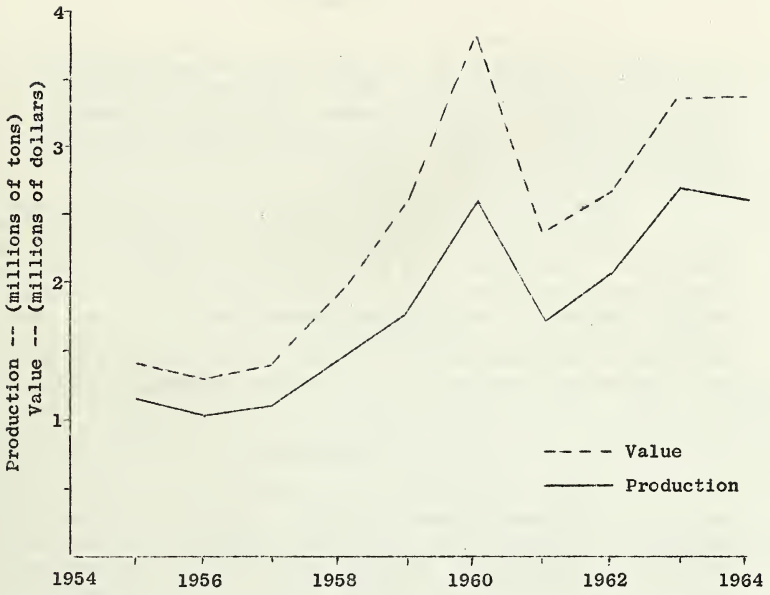

Fig. 5 - Production and value of crushed and broken stone in the Extreme Southern Illinois Region, 1954 to 1964.

STONE

Crushed and Broken Limestone

In Illinois the principal products of the stone industry are crushed and broken limestone and dolomite for use in concrete roads and structures, for road surfacing, and for agricultural limestone (agstone). The Extreme Southern Illinois Region contains an abundance of carbonate rock resources that vary greatly in geologic age, degree of purity, and thickness. A comprehensive report on these resources was published by Lamar (1959). Figure 4 shows the areal distribution of the various stone resources in the region and the location of quarry operations reported in 1964.

Production and value of crushed and broken stone produced in extreme southern Illinois from 1955 to 1964 appear in figure 5. In 1964, 14 quarries were operating in five of the counties of this region, and their combined production amounted to 6.7 percent of the state's total stone production for that year. The three leading counties, in order of tonnage produced in 1964, were Union, Johnson, and Hardin.

Building Stone

Illinois contains a variety of limestones, dolomites, and sandstones that are being used, have been used, or have possibilities for use as sources of veneering stone, rough-construction stone, flagstone, ashlar, rubble, and stone for other purposes. According to a detailed report on the state's building stone resources by Lamar and Willman, numerous rock units in extreme southern Illinois have potential use as building stone (Lamar and Willman, 1955, p. 16-22).

The Lutz Marble Company operates a quarry (fig. 4) about 6 miles south of Anna from which it produces "Salem" limestone for sale as dimension stone. This stone, from the Harrodsburg Formation, resembles the famous Indiana limestone which is produced from the Salem Formation near Bedford, Indiana. In fact, the two stones compete with each other in some markets. Both Indiana Salem Limestone and Illinois "Salem" limestone have been used in the State Hospital at Anna and the Illinois stone compares quite favorably. The company also produces commercial marble.

Sandstones

In 1955, Biggs and Lamar prepared a report on the sandstone resources of extreme southern Illinois. Twenty-five outcrops were sampled and tested. Mineral composition, grain shape and size, and chemical composition were determined. Washing, acid treatment, and removal of magnetic particles decreased the iron-oxide content of five samples to below .035 percent and of one sample to below .02 percent. Test results suggest that, if properly processed, some southern Illinois sandstones could yield silica sand suitable for industrial uses such as glass sand, synthetic molding sand, and abrasive sand.

Terrazzo Chips

Terrazzo is a widely used type of flooring made by mixing cement and water with small, graded chips of marble, limestone, or dolomite. The mixture is poured into place and allowed to harden. The surface is then ground smooth with abrasive wheels and finally waxed and polished (Harvey, 1962).

In the past, all terrazzo aggregates used in Illinois were imported from other states or countries. Although a variety of Illinois limestones probably can be used as terrazzo aggregates, two from southern Illinois are especially promising—certain black or near-black limestones from Hardin County and a reddish brown limestone from Alexander County.

Terrazzo chips that were successfully used in the new State Hospital building at Alton, Illinois, and in several other buildings in southern Illinois were produced from stone quarried near the village of Gale in Alexander County. Since this Illinois terrazzo proved to be satisfactory, plans for expanding production are being made.

CEMENT

In 1963, Massac County became the third county in Illinois to have cement production when Missouri Portland Cement Company completed construction of a new dry-process cement plant near Joppa (fig. 4). The plant has an annual capacity of 3 million barrels and is capable of producing both masonry and portland types of cement. It is equipped with a 550-foot coal-fired kiln with a 8500-barrel per day capacity. Limestone for the plant is quarried and crushed near Cave in Rock in Hardin County, and then barged down the Ohio River to the Joppa plant (U. S. Bur. Mines, 1964, p. 382).

CLAY AND CLAY PRODUCTS

The northern part of the Extreme Southern Illinois Region is underlain in part by clays and shales of Pennsylvanian and older ages. Exposed locally in the southern part are Cretaceous and Tertiary clays (fig. 6). Although at present the only clay processing plant in operation is at Olmsted, there is potential for expansion in the utilization of these resources.

To evaluate the clay resources of Illinois, numerous samples from many parts of the state have been collected and tested by the Illinois Geological Survey. Test results were published in Circulars 303 (White and Lamar, 1960), 352 (Parham and White, 1963), Bulletin 38D (Parmelee and Schroyer, 1921), and Report of Investigations 128 (Lamar, 1948). Figure 6 shows the sample collecting localities. More than 70 samples were taken from the Extreme Southern Illinois Region for testing. Suggested uses for these clays were many and varied, including drain tile, structural clay products, flower pots, stoneware, face brick, architectural terra cotta, and certain types of refractories.

The extent of the sizeable deposits of strippable refractory clays located in southern Illinois is shown on figure 7. The term "strippable" is used rather loosely to indicate those general areas where the ratio of overburden to clay thickness falls within the generally accepted limits of present mining practice. More detailed information on locations and types of clay resources can be obtained from personnel of the Illinois Geological Survey. However, it should be noted that Union County has one of the few deposits of super-duty clay in the state, and that Massac County has some deposits of high-duty clay (White and O'Brien, 1964).

Because transportation costs constitute a substantial portion of the final delivered price of many clay products, production of these goods is generally concentrated in or near metropolitan areas, which are the major markets. Because the region does not include and is not near large cities, the future of the clay and clay products industry is limited.

Illinois has a sizable clay products industry which has produced between 50 and 60 million dollars worth annually over the past decade. However, the Extreme Southern Illinois Region contributes only a minor part of

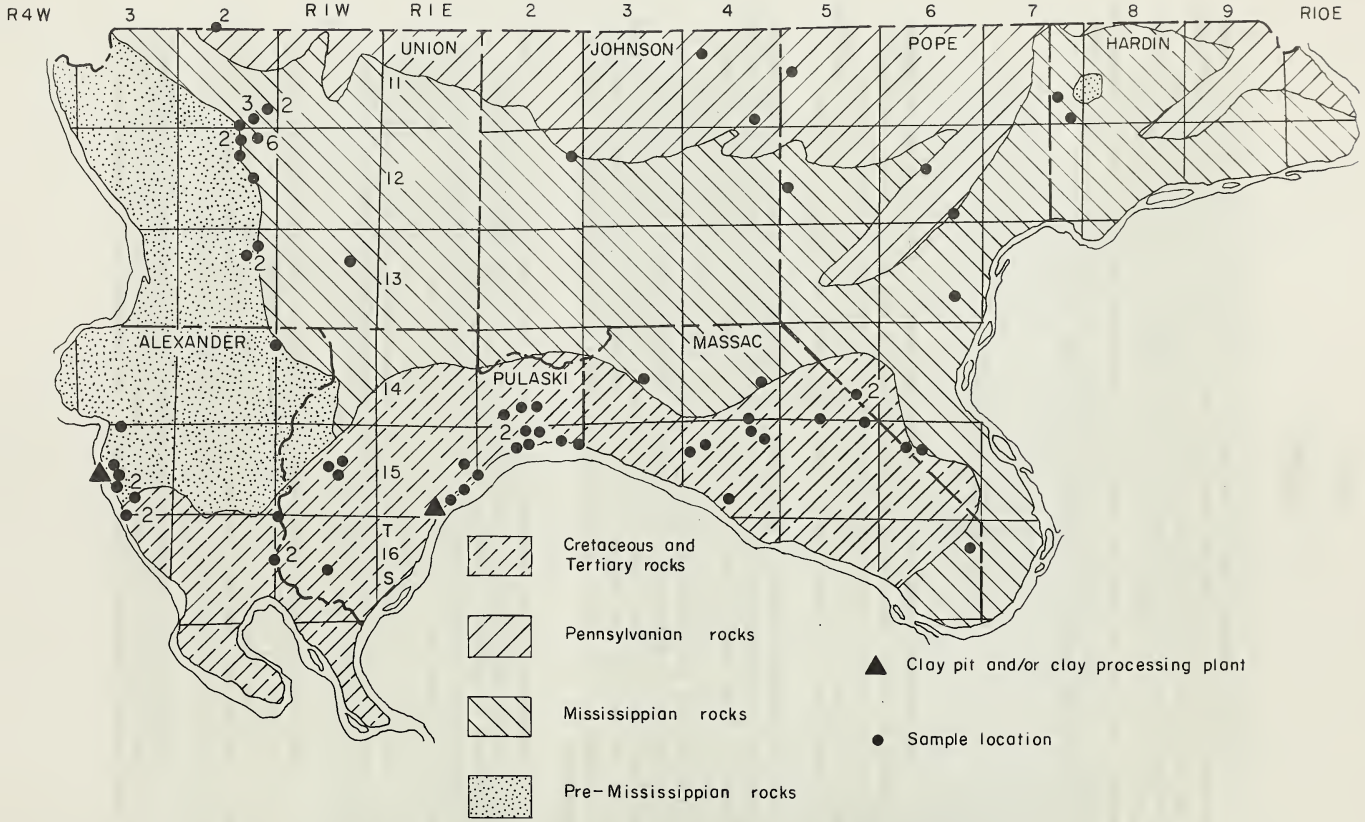

Figure 6 - Clay resources and operations in the Extreme Southern Illinois Region. (Data from White and O'Brien, 1964; White and Lamar, 1960; Parham and White, 1963; Parmelee and Schroyer, 1921; Lamar, 1948.)

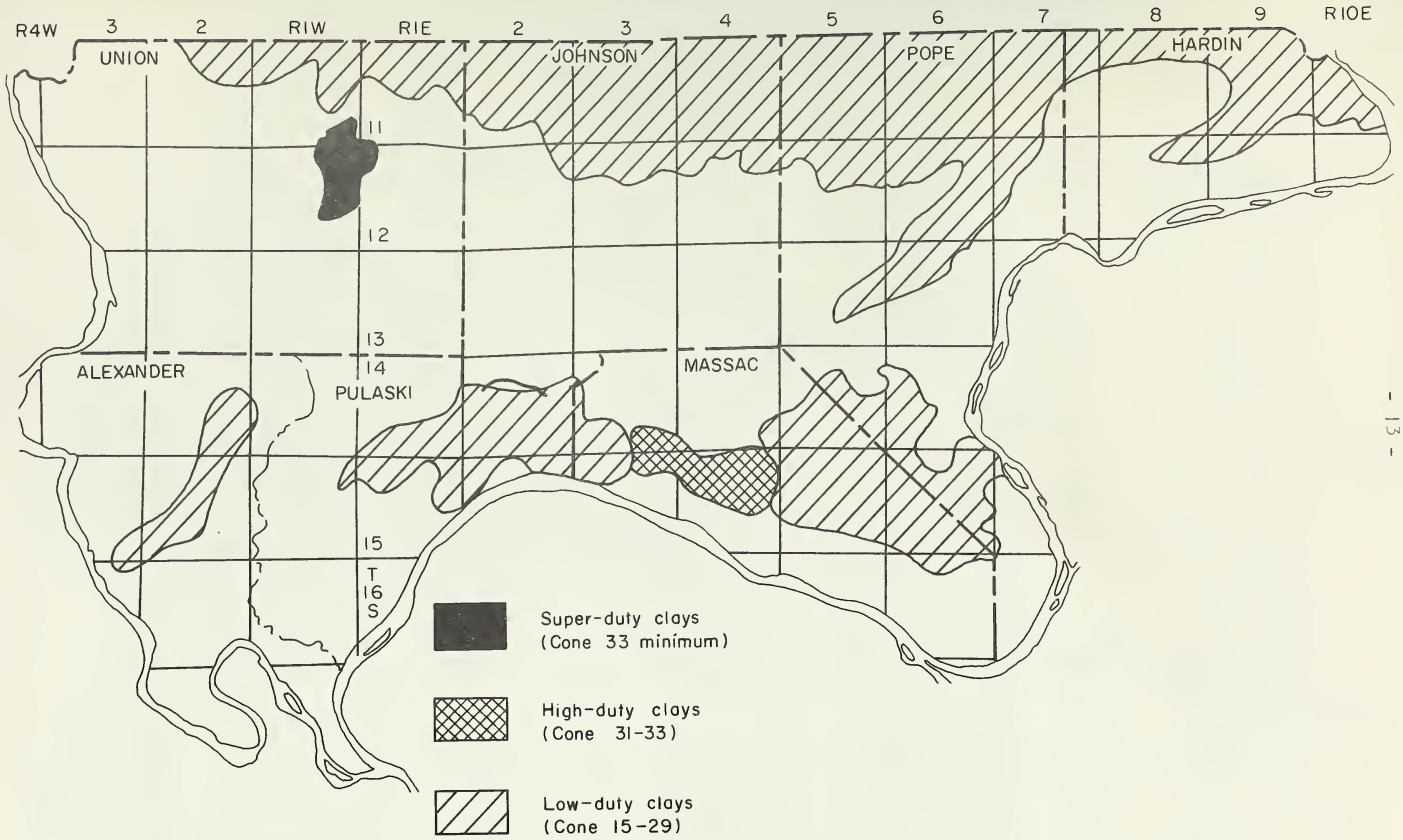

Figure 7 - Strippable refractory clays in the Extreme Southern Illinois Region.
(Data from White and O'Brien, 1964.)

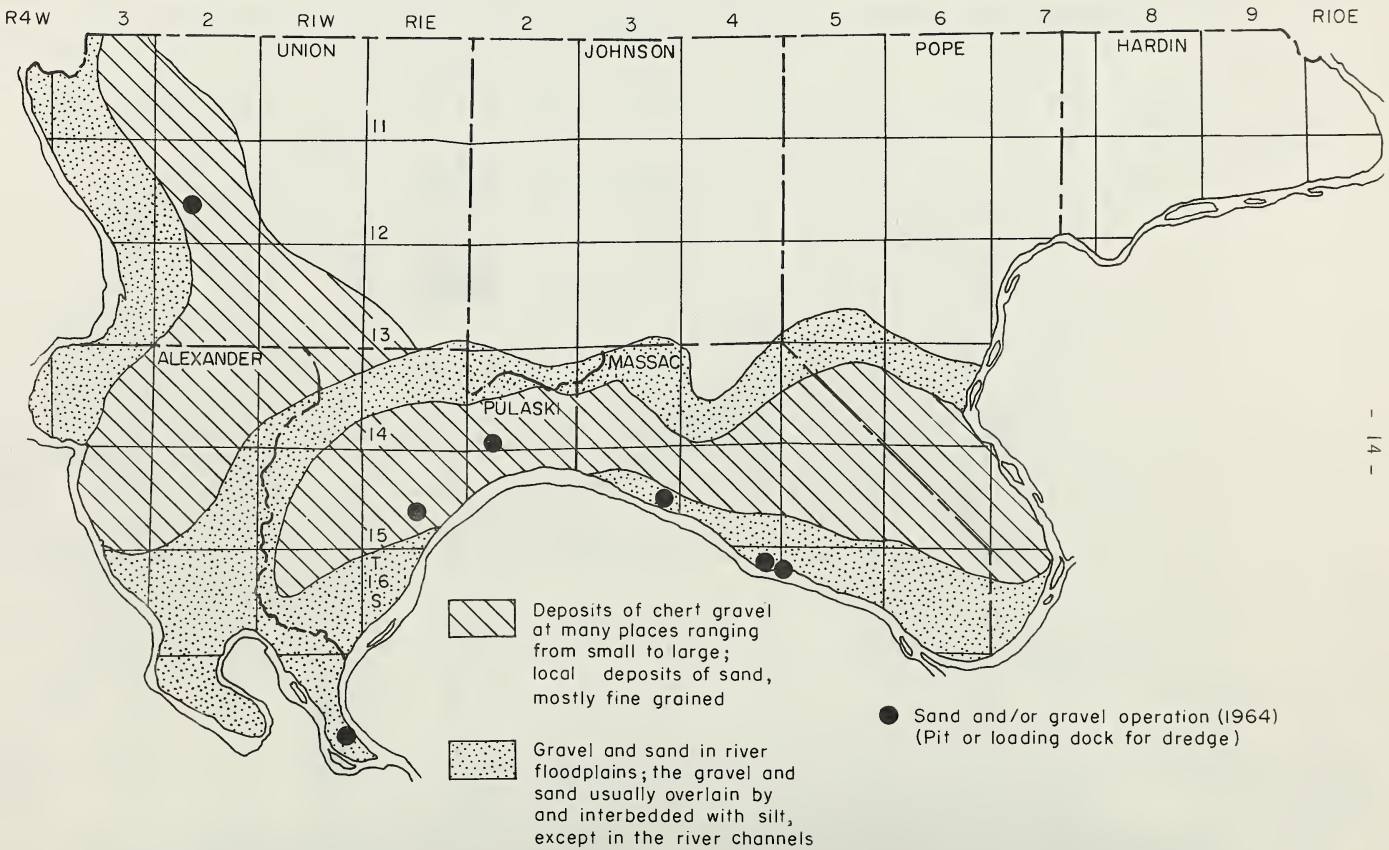

Figure 8 - Sand and gravel resources and operations in the Extreme Southern Illinois Region (geology from map by G. E. Ekblaw).

this. In recent years the area has had only two producers of clay and clay products, one in Alexander County and one in Pulaski County (fig. 6). Ozark Minerals Company at Thebes has produced very small tonnages of raw clay on a sporadic basis. Star Enterprises, Inc., of Cassopolis, Michigan, operates a plant near Olmsted, in Pulaski County, which produces processed clay from the Porters Creek Formation. This clay is sold for animal litter, adsorbent cleaning compounds, and for other special uses.

SAND AND GRAVEL

The extreme southern part of Illinois was not glaciated and for this reason its sand and gravel deposits differ from those found elsewhere in the state. The deposits are of two main types—chert gravels and river floodplain deposits (fig. 8). Additional deposits are found in the river channels themselves. Further information on the sands of the region can be found in the report by Shrode and Lamar (1953). It is not possible to give any meaningful data on reserves. Sand and gravel, being low value commodities, are usually sharply restricted to the nearby market areas in which they can profitably compete.

Production of sand and gravel in the Extreme Southern Illinois Region has been small and variable. In 1964 there were eight operations in four counties. For the past decade production has generally come from so few producers that the data has been withheld from publication to avoid divulging confidential information. Total production of sand and gravel from extreme southern Illinois in the recent past has been less than 1 percent of the total state production for any given year.

SILICEOUS MATERIALS

Alexander and Union Counties in the western part of the Extreme Southern Illinois Region contain several mineral materials largely or entirely restricted to this part of the state. Included are amorphous silica (tripoli), novaculite, ganister, and chert gravels.

"Tripoli" is a technical name for "a number of comparatively soft, porous, friable, microcrystalline silicas of sedimentary origin" (Lamar, 1953, p. 5, 8). Commercially, the southern Illinois tripoli is known as "amorphous silica." Most of the silica produced in this region has come from the Clear Creek Chert of Devonian age. Although the major source area is the Mill Creek—Elco region (fig. 9) in Union and Alexander Counties, the producing formation underlies a considerably larger area, and additional deposits may exist outside the present mining area.

At the present time silica (tripoli) is being mined and milled by Ozark Minerals Company at Elco and by Tamms Industries Company at Tamms. It

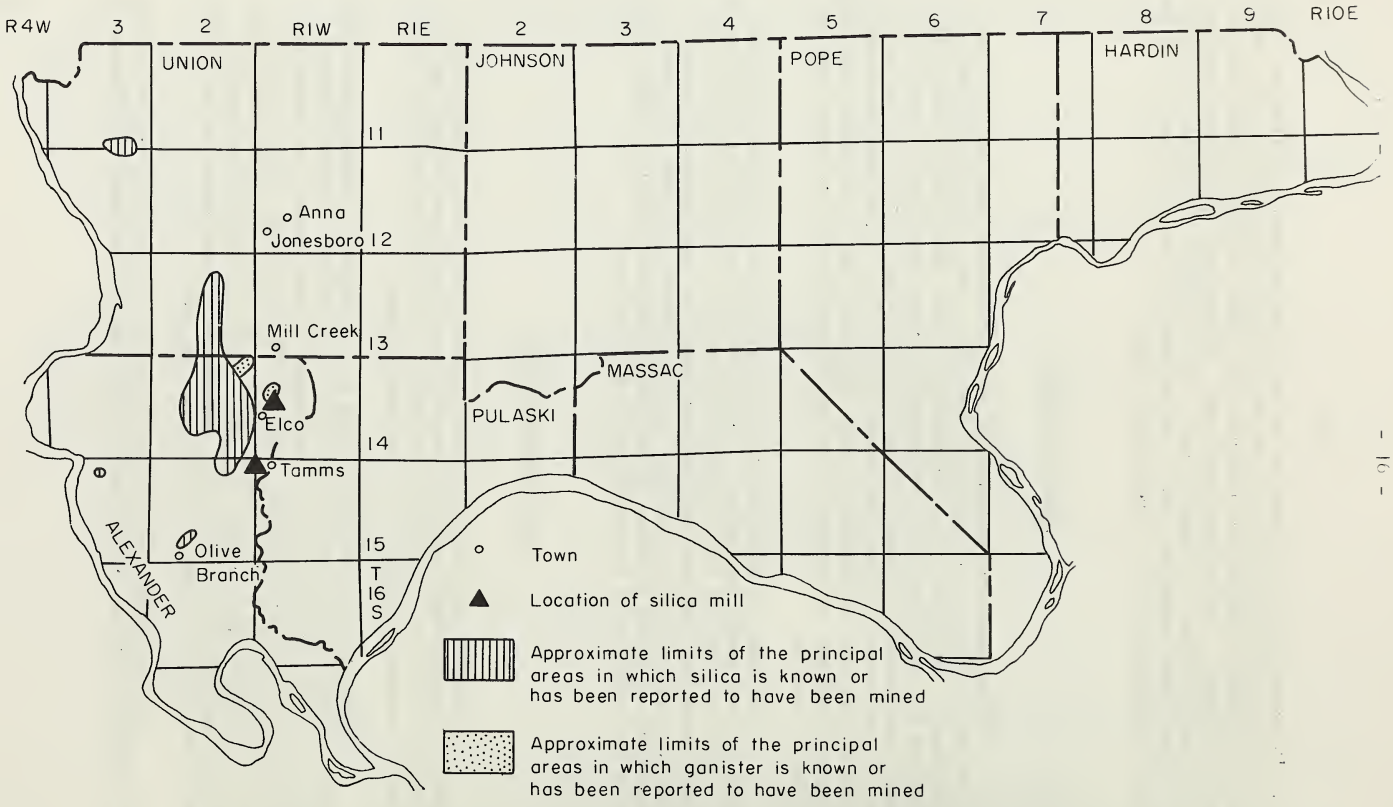

Figure 9 - Siliceous materials resources and operations in the Extreme Southern Illinois Region (from Lamar, 1953).

is used to polish optical lenses (superfine grade), in scouring compounds, metal polishes, paints, electrical resistors, high-temperature pipe coverings, fiberglass manufacture, plastics, silicone rubber, wood filler, and for many other purposes (Lamar, 1965, p. 34).

A second siliceous resource in extreme southern Illinois is ganister, "a high-silica material, usually white, cream, light yellow, or red, which is loosely consolidated and readily disintegrated into irregular particles an inch or less in size" (Lamar, 1953, p. 27). Sizable tonnages of ganister are believed to be availabe in the Mill Creek—Elco area, but additional exploration will be required to determine the extent and grade of these deposits.

Ganister has been mined near Mill Creek on an intermittent basis for a number of years by the Western Fire Brick Company of Granite City, Illinois (fig. 9), for use in the manufacture of refractories.

In addition to the above-mentioned resources, there are several more types of siliceous materials of relatively minor importance. They are chert (novaculite), calico rock, and chert gravels including novaculite gravel, Elco gravel, and "Lafayette" gravel. No novaculite or calico rock is being mined in 1966, but a little production was reported in the past. Relatively small tonnages of chert gravels are used as road surfacing material.

COAL

The southernmost coal-bearing rocks of the Pennsylvanian System in Illinois extend into the northern part of the region, but they cover a relatively small area. Minor production has been reported from Johnson, Pope, and Hardin Counties, but none since 1956 (fig. 10). Limited information from the area indicates that the coals that do exist occur only locally in minable thicknesses. Therefore, no estimate of reserves has been attempted by the Coal Section of the Illinois State Geological Survey (W. H. Smith, 1966, personal communication).

OIL AND GAS

No oil or gas has been produced in the Extreme Southern Illinois Region, but two of the major natural gas pipelines in the state pass through it (fig. 11). These pipelines are supplied with natural gas produced in east Texas and Louisiana.

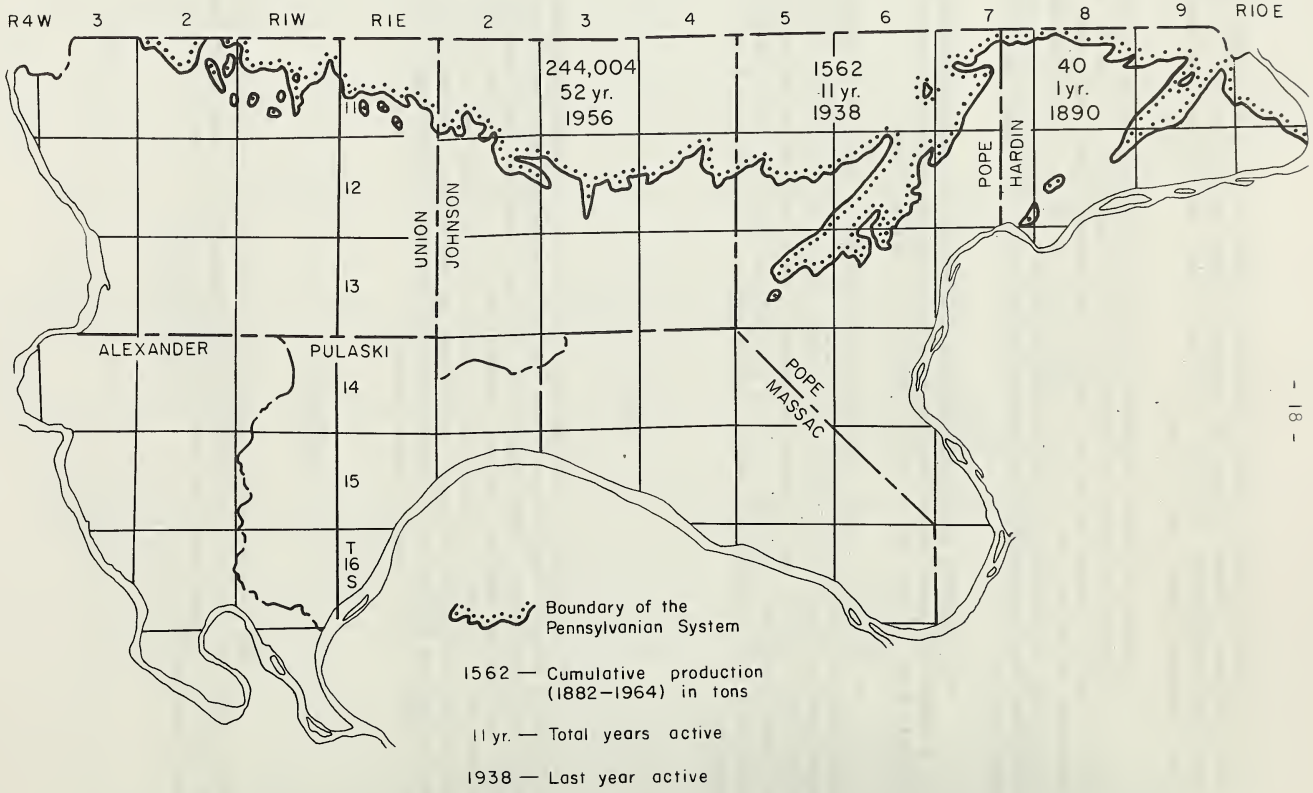

Figure 10 - Cumulative coal production by county (1882-1964) in the Extreme Southern Illinois Region. (Source: Illinois Department of Mines and Minerals and Illinois Geological Survey.)

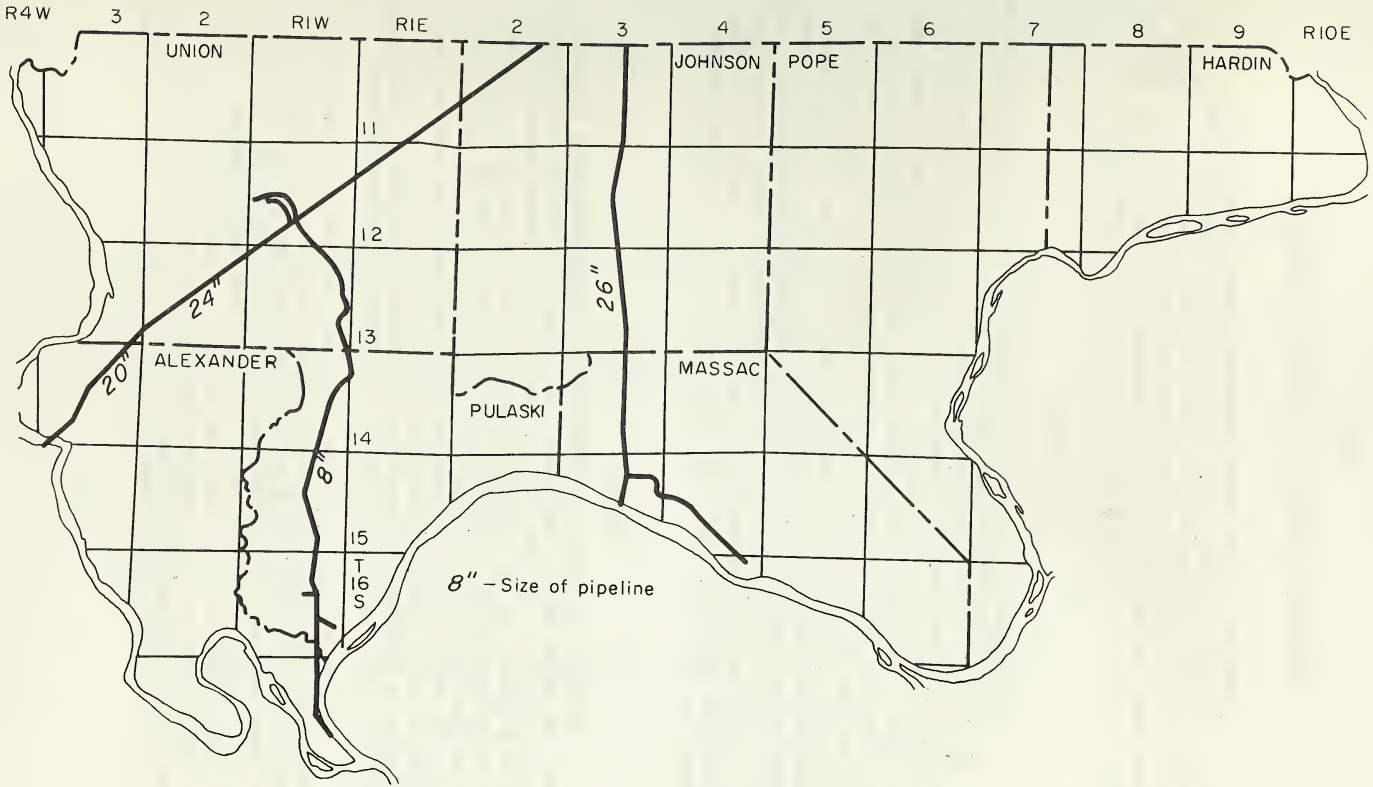

Figure 11 - Natural gas pipelines in the Extreme Southern Illinois Region (from Illinois State Geological Survey map, Oil and Gas Industry in Illinois, by W. F. Meents and A. H. Bell, 1961).

UNDEVELOPED MINERALS OF POTENTIAL IMPORTANCE

In addition to the above mentioned mineral resources that are being or have been exploited, three other minerals occur in extreme southern Illinois—feldspar-bearing sands, oil shale, and barite. The low grade of these minerals and/or high processing costs have thus far made them uneconomic to exploit. A brief discussion of these resources and the problems associated with their utilization is given below.

Oil Shale

The presence of oil in certain shales in Illinois was reported as early as 1870, but no comprehensive tests of these shales were made until 1956. At that time members of the staff of the Illinois State Geological Survey collected and tested 114 samples from localities in 41 counties. The results of this work were published in Circular 208 (Lamar, Armon, and Simon, 1956). Nineteen of the samples were taken from locations in the Extreme Southern Illinois Region. Of these, only one (D-36) yielded more than 10 gallons of oil per ton of shale. Although many of these shales were among the thickest tested, being 25 feet thick at one locality, the southern Illinois deposits are generally thinner than the oil shales found in the western United States. As the thick deposits of Colorado, Utah, and Wyoming average more than 30 gallons of oil per ton of shale, any economic use of the Illinois oil shales will be in the future. Figure 12 indicates the locations and yields of the oil shale samples tested and reported in Circular 208.

Feldspar-Bearing Sands

Feldspar, an essential constituent in the manufacture of glass, pottery, and other ceramic materials, is a mineral component of many Illinois sand deposits. In 1964 Illinois was the third largest domestic consumer of feldspar, using 73,967 tons, all of which had to be imported as there was no production of feldspar in the state. At present, feldspar is imported from Colorado, South Dakota, and North Carolina and, therefore, substantial freight costs are involved. For this and other reasons, some research has been directed toward determining whether certain Illinois sands might be beneficiated to produce a feldspar concentrate of acceptable grade that could supply all or part of the state's needs more cheaply.

Figure 13 gives the locations of the sand samples tested by Willman (1942) and Hunter (1965) for feldspar content. Five samples of feldspar-bearing sands—three from the Ohio River, one from the Mississippi River, and one from a sand deposit in Union County—were collected by Willman. Hunter restudied two of Willman's samples and tested an additional sample from the Ohio River near Golconda. The highest potash feldspar content occurred in the sample taken from the sand in Union County. The quantity of sand actually available has not been determined. Deposits along the Ohio and Mississippi Rivers are quite extensive. The Ohio River

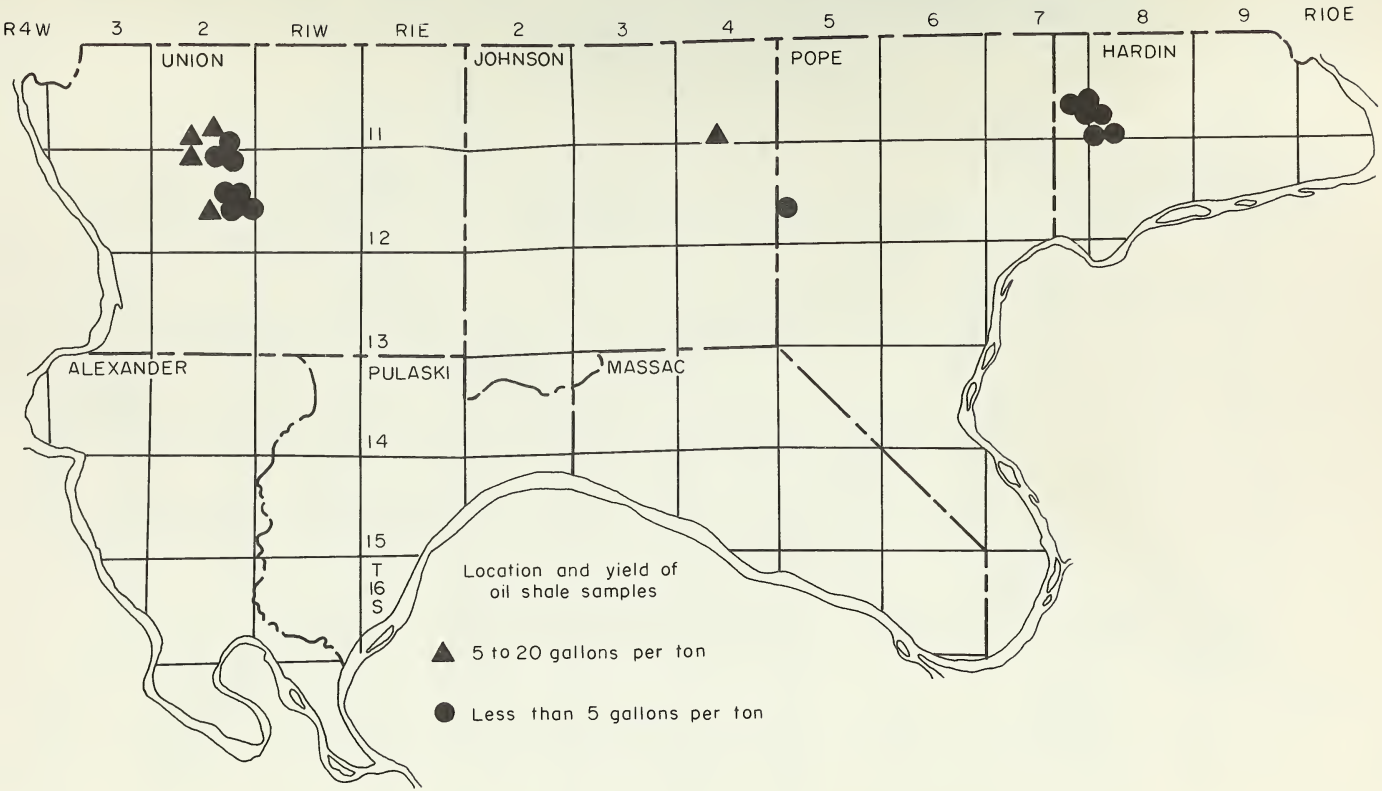

Figure 12 - Oil shale resources of the Extreme Southern Illinois Region (Lamar, Armon, and Simon, 1956).

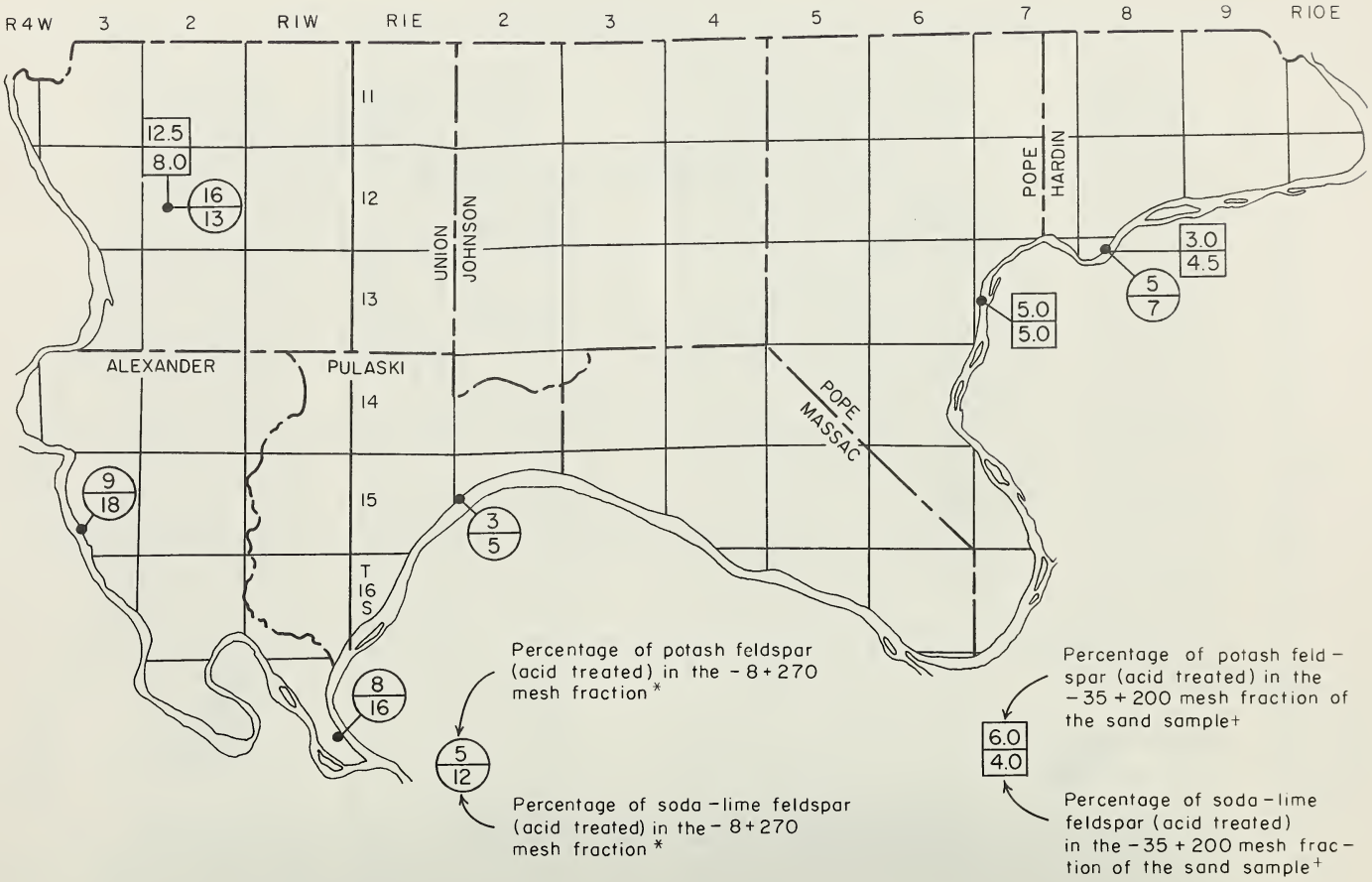

Figure 13 - Feldspar-bearing sands in the Extreme Southern Illinois Region (Willman, 1942*; Hunter, 1965+).

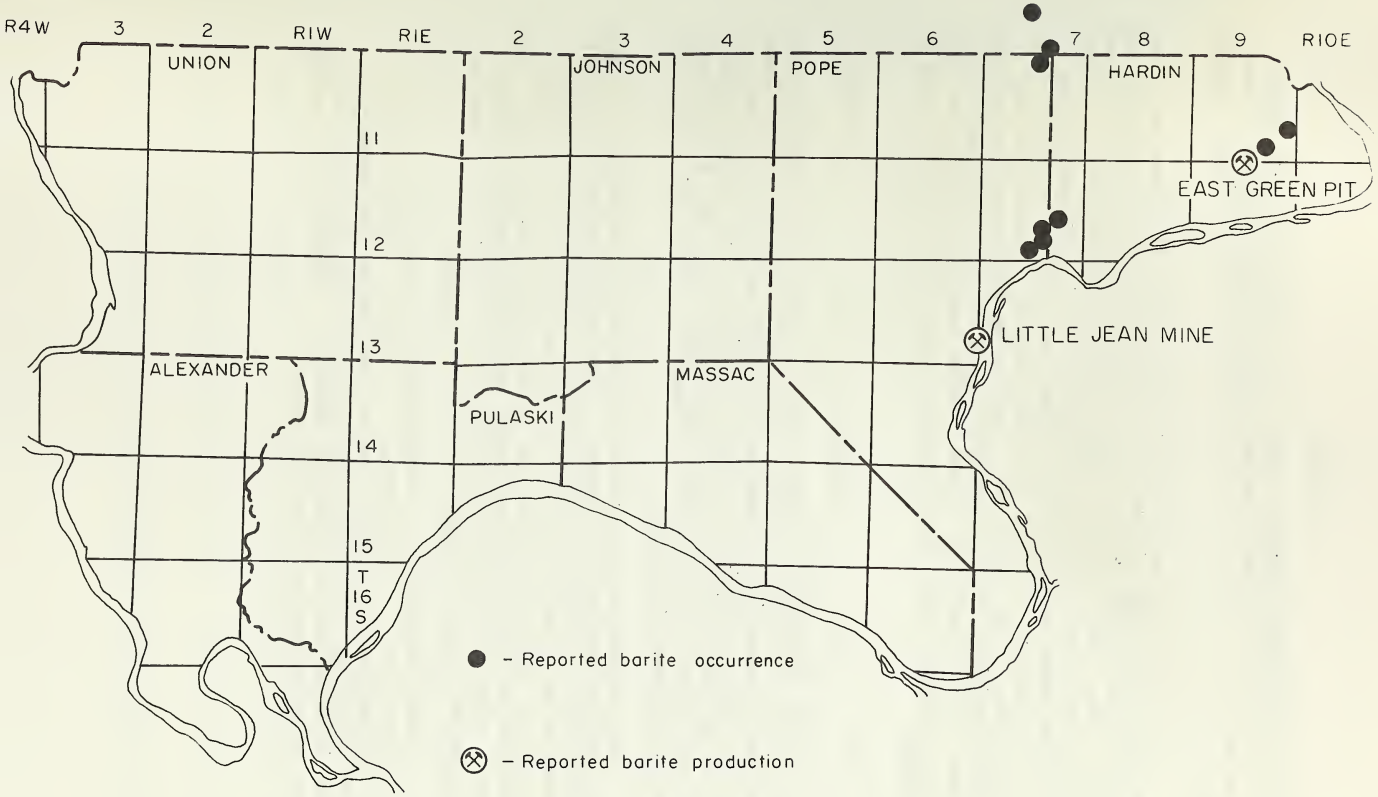

Figure 14 - Barite resources in the Extreme Southern Illinois Region (Bradbury, 1959).

samples had low feldspar contents, with the sole exception of the sample taken at Cairo, which yielded 24 percent total feldspar. The sample from Thebes on the Mississippi River is notable for its high soda-lime feldspar content.

A key factor in the utilization of feldspar for ceramic and glass purposes is the iron oxide content. The maximum allowable for flint (clear) glass is 0.05 percent iron oxide (Fe_2O_3); for amber glass it is 0.50 percent (U. S. Bur. Mines, 1965, p. 322). Hunter (1965) studied the mode of occurrence and amount of iron oxide in the feldspars of his sand samples. He found that the sands contain potash feldspar, soda-lime feldspar, and feldspathic rock fragments, and that the potash feldspar contains less iron oxide than either of the other forms. When the feldspars were treated with acid in the laboratory, their iron oxide content was reduced to near commercial grade. Treated samples of potash feldspar contained from 0.10 to 0.31 percent iron oxide, whereas the treated soda-lime feldspar had from 0.16 to 0.56 percent.

Barite

As was previously mentioned, barite is often associated with the fluorspar found in southern Illinois. Barite, also known as barytes, heavy spar, and tiff (Missouri), is a nonmetallic mineral of high (4.5) specific gravity. In 1964, 87 percent of the barite produced in the United States was used as drilling mud by the petroleum industry (U. S. Bur. Mines, 1965, p. 239). The glass, paint, and rubber industries, in that order, were the next largest consumers of barite.

The locations of known barite occurrences in the southern Illinois fluorspar district are shown in figure 14. The Little Jean Mine, located south of Golconda, is the only mine in Illinois that has been operated to produce barite exclusively. The mine is said to have been active commercially from 1918 to 1922, when the vein "pinched out" (Bradbury, 1959, p. 6). The East Green pit, north of Cave in Rock, has produced barite-fluorite concentrate, which was sold under the trade name "fluorbarite" for use in the glass manufacturing industry (Bradbury, 1959, p. 12).

Although barite occurs throughout the district and in all the fluorite-bearing rocks, its distribution is irregular, and all evidence suggests that the barite concentrations are much smaller than those of fluorspar. Therefore, barite can probably be mined most profitably as a by-product or co-product of a fluorspar operation. Bradbury's 1959 report discusses the known occurrences in some detail.

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